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Introduction

When the Southern Corn Leaf Blight (Bipolaris maydis race T = Helminthosporium maydis) epidemic devastated the corn crop throughout the Corn Belt in 1971, plant pathologists scrambled for information on the survival of this pathogen. Little information was available, but the standard answer was very simple and effective, "Plow your corn ground and rotate to another crop" (R. R. Nelson - 1971 on the Today Show). The rapid transition from "T" male sterile cytoplasm to normal cytoplasm eliminated the very susceptible host, but sanitation (plowing) and crop rotation are two of the most effective means of controlling plant diseases.

If disease control, especially foliar diseases is so simple, why am I writing this paper about the management of plant diseases. There are two main reasons for concern: 1) plowing is no longer considered an acceptable means of controlling plant pathogens, and 2) many government programs, value of the crop, herbicide usage, or many other factors, some farmers choose to plant corn following corn. While most plant pathologists, entomologists, and weed scientists are aware of the problems, many farmers have done this very successfully for years. We started studying the effect of tillage on corn diseases in 1985 and have continued for nine years. My general conclusion is "the more research we do, the more questions we ask, and the more we realize how little we know."

Seedling blights.

There are several very important plant pathogens that affect seedlings. They can either prevent emergence, post-emergence death, or reduce plant growth resulting in stunted plants. Virtually 100% of all seed corn sold in the U.S. has been treated with captan. A much smaller percentage of soybeans are treated with fungicides, but that percentage is increasing. Captan was released in the early 1950's and is considered a "broad-spectrum" fungicide, but is not very effective against fungi from the Oomycete group, examples are *Pythium* and *Phytophthora.* These pathogens are especially important in soils with high soil moisture. Captan is applied from 350 to 750 ppm, depending upon formulation, and seed companies have tended to increase the concentration over the past 5-10 years.

We initiated a study in 1992 to compare rates of captan in conventional vs. no-till soils. The entire field was cropped to corn the previous year and the conventional tillage was chisel-plowed in the fall and field cultivated in the spring prior to planting. The no-till section received no tillage prior to planting. All plots were planted with a John Deere MaxEmerge corn planter equipped with Yetter no-till coulters. Force insecticide was applied at planting and fertilizer and herbicides were applied after planting. Two commercial hybrids were used and captan rates ranged from 0 to 900 ppm. The soil temperature at planting in 1992 was 53° F for the no-till and 61° F for the conventional tillage treatment. In 1993, the soil temperatures were 54° F for the no-till and 62° F for the conventional tillage. Emergence was determined five weeks after planting. Seedlings in the conventional tillage treatment emerged faster and were more vigorous in both years. We found 350 to 450 ppm of captan was sufficient to achieve over 90% stand in the conventional tillage. However, we found the maximum stand was achieved at 650 ppm in 1992 and 600 ppm in 1993 for the no-till plots. The maximum stand in the no-till plots in 1992 was nearly 90% of the kernels planted, but only 80% in 1993. This reduction in population is a major concern for no-till and additional research is needed. The areas that we are concentrating on are: i) seed placement and covering, ii) seed quality, iii) seed protectants and iv) biological control.

We also have done several years of research on seed protectants for soybeans. Under conventional tillage and using a non-determinant variety planted in 30" rows, we have seldom demonstrated a yield increase with any seed protectant. In 1993, we evaluated a number of seed protectants using both a non-determinant and a determinant variety under reduced tillage. Both varieties had lower stands with no seed protectants, but only the determinant variety exhibited a significant yield increase. As growers change from conventional tillage to either reduced tillage or no-till, I believe uniform plant emergence and stand is going to be more important. With no-till comes cooler and wetter soils, thereby increasing problems with many soil-borne plant pathogens.

Foliar Diseases

As I indicated in the introduction, the Southern Corn Leaf Blight epidemic plant pathologists evaluated the survival of plant pathogens in debris. Art Hooker (University of Illinois) did a rather simple experiment during the winter of 1971 (Ulstrup, 1971). Hooker collected corn leaves infected with *Bipolaris maydis* race T, placed them in mesh bags, and incubated them in the field. The bags were either buried, left on the surface, or suspended above the surface. Every month he would collect the bags and determine the viability of the fungus. Leaf tissue buried under the soil was decomposed and *B. maydis* could not be recovered from the tissue after February. The pathogen could be isolated from leaf tissue left on the surface and suspended above the surface the following spring. This led him to conclude that plowing was an effective means of controlling foliar diseases. Other scientists have done similar studies on other foliar pathogens and found similar results. These studies also tell us that no-till, which leaves most of the plant debris on the surface of the soil is an ideal environment for foliar pathogens to survive.

With the increase in no-till and continuous corn, we were concerned about the possibility of an epidemic occurring with Northern Corn Leaf Blight. We started the experiment by planting a susceptible corn hybrid and inoculating it with *Exserohilum turcicum* = *Helminthosporium turcicum*. The disease developed and approached 70% disease severity just prior to senescence. We evaluated three tillage treatments: i) no-till, ii) ridge-till, and iii) conventional-till, which was fall chisel-plowing and spring cultivation. Three hybrids were selected and plots were evaluated for disease severity, stalk rot, and yield. In the no-till, disease severity was very high for the susceptible hybrid, while the resistant hybrids had little disease. In the conventional-till plots, disease was very low, except secondary spread from the no-till plots. In the ridge-till plots, disease was similar to the conventional-till the first year, but similar to the no-till the second year. One difference between the two years was the planter used. In year one, a planter with "trash-whips" was used for all treatments. When the ridge-till plots were planted, approximately 3" of soil was removed from the top of the ridge and spread over the valley. This covered the plant debris from the previous year with a thin layer of soil. In the second year, a no-till fluted coulter was used and none of the soil was spread over the debris in the valley between the ridges. In this year, ridge-till was very similar to no-till. We believe the covering of the debris, while not as effective as plowing, decomposed the debris and thereby reduced the amount of initial inoculum. It appears that any tillage, even in the spring is better than no tillage for reducing foliar pathogens. When we evaluated the two resistant hybrids, we found the type of tillage had no effect on foliar disease and disease levels were very low. Thus, most growers have escaped problems with foliar diseases by selecting hybrids with high levels of disease resistance. Interestingly, the highest yield in both years occurred on the conventional-till and ridge-till plots, while the no-till plots had the lowest yields. In this study stands were uniform and the reduction in yield associated with no-till was not due to stand reduction (Pedersen, et al. 1993).

The same general principles apply to foliar diseases for soybeans. If the plant debris is allowed to remain on the surface of the soil, plant pathogens will survive. If the debris comes in contact with soil via tillage, plant pathogens will generally be reduced. However, as I stated earlier, tillage may not be possible.

Conclusions

To control both wind and water erosion, farmers are learning to maximize yield under no-till. This requires the seed companies to sell the farmers the best quality seed. The more progressive seed companies have concentrated on improved handling equipment and quality control. They also have cooperated with the chemical companies to identify superior seed protectants, as well as developing biological controls. The agricultural engineers are working on field equipment that do a better job of placing the seed in the soil in an environment that will promote germination and growth. Finally the farmers are been far ahead of the universities in trying new systems for no-till. They are aware of the need for crop rotation, genetic resistance,

improved machinery, and high yielding hybrids and varieties. They are the individuals that must implement this research.

References

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